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Vol. VII JUNE, 1920 No. 6

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"Thames River Bridge." James W. Rollins.
Memoirs of Deceased Members.

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DESIGNERS SECTION

At a meeting of the Board of Government held April 2, 1920, the following petition was received:

BOSTON, MASS., March 17, 1920.

To the Board of Government,
Boston Society of Civil Engineers,
Boston, Mass.

Recently there have been held in the Society Library three informal meetings for the discussion of problems of design, particularly for the benefit of the younger members of the Society engaged in design work. The success of these meetings indicates that there is a demand for meetings of this character, and that the usefulness of the Society will be extended by continuing along these lines in a more substantial way, than by informal action, as has been the case thus far.

It is believed that this can be done to the best advantage by the formation of a Section devoted to such a purpose. In this way the movement will be more likely to be self-supporting and permanent, there will be greater opportunity for the development of the younger men in official capacity, and there will be a greater sense of dignity in the undertaking than would be the case if the matter is handled by a committee.

In view of the above considerations, the undersigned, members of the Boston Society of Civil Engineers, respectfully request the Board of Government in its discretion to establish a Section to be known as,

"The Designing Engineers Section of the Boston Society of Civil Engineers," in accordance with paragraph 13 of the By-Laws.

Respectfully submitted,

(Signed)

Frank A. Marston.
Philip W. Taylor.
A. L. Shaw.
Arthur B. Appleton.
W. Newell Wade.
R. E. Rice.
H. C. Sheils.
Howard C. Thomas.
Elmer P. Rankin.
Harrison P. Eddy, Jr.
Ralph W. Horne.
Carroll A. Farwell.
John W. Raymond.
Arthur P. Rice.
Arthur P. Porter.
B. A. Bowman.
Philip B. Walker.
B. A. Rich.
Leroy G. Brackett.
John P. Wentworth.
K. C. Reynolds.

After a full discussion it was voted unanimously to establish a Section of the Society to be known as "The Designers Section of the Boston Society of Civil Engineers."

S. E. Tinkham, *Secretary.*

Boston, April 7, 1920. — The Board of Government having authorized the organization of a Designers Section of the Boston Society of Civil Engineers, following a petition requesting that action submitted under date of March 17, 1920, with 21 signers, a meeting was called to order, with 23 present, by Secretary Tinkham of the Society.

Mr. Philip W. Taylor was elected temporary chairman, and, following a vote of those present to that effect, appointed the following as a committee to submit nominations for officers and to draft a set of by-laws for the new Section: Messrs. Ralph W, Horne, Ernest D. Mortenson, Arthur L. Shaw, Frank A. Marston. Philip W. Taylor and Carroll A. Farwell.

Mr. B. A. Rich was then introduced and discoursed upon the subject of "Small Concrete Highway Bridges." Many interesting features of the design and construction of numerous bridges of this character built for the Metropolitan Park Commission were outlined, and the discussion which followed was instructive.

The meeting adjourned at 7.45 P.M.

Reported by

A. L. SHAW.

BOSTON, April 28, 1920. — A meeting of the Designers Section was called to order by Mr. Frank A. Marston in the absence of the temporary chairman, Mr. Philip W. Taylor. Mr. Marston explained that, due to a misunderstanding about the date, Mr. Mark Linenthal, who was to speak on "Concrete Ships," was unable to be present. The meeting then proceeded to the business of the evening.

A motion was made and seconded that Mr. Marston act as temporary chairman, and was unanimously carried.

Motion was made that Howard C. Thomas act as temporary clerk. Motion carried.

Mr. Marston then read the report of the Committee on Nominations, appointed at the meeting of April 7, 1920.

It was moved and seconded that this report be accepted and that the Clerk be instructed to cast one ballot for the men nominated. The Clerk cast the ballot, and the following officers were declared elected:

Chairman — Ralph W. Horne.
Vice-Chairman — Ralph E. Rice.
Clerk — Arthur L. Shaw.

Additional members of Executive Committee:

Philip W. Taylor.
Henry C. Sheils.
Frank A. Marston.

Mr. Marston then retired in favor of the chairman-elect, Mr. Horne, who thanked the men for his election, and predicted a bright future for the Section if every one does his part.

The report of the Committee on By-Laws was read by

Mr. Horne. Each section was then discussed and action taken as shown in detail in the proposed By-Laws.*

It was moved and seconded that the By-Laws as amended go into effect upon approval by the Board of Government and this Section. Motion carried.

It was moved and seconded that the Clerk transmit a copy of the By-Laws to the Board of Government for approval. Motion carried.

It was also moved and seconded that the Clerk record the names of all members present at the meeting. Motion carried.

It was moved and seconded that all members of the Boston Society of Civil Engineers who were signers of the petition of March 17, 1920, to the Board of Government, all members of the Society who have presented their names to the Secretary of the Society as interested in this Section, and all members present at this meeting, shall be considered as the charter members of the Section. The motion was carried.

It was moved and seconded that the Clerk be instructed to include in the records of this meeting a copy of the petition of March 17, 1920, to the Board of Government for the organization of this Section, the action of said Board and a statement of the business of the meeting of April 7, 1920.

Chairman Horne then closed the meeting with a few well-chosen remarks, urging all members to push the Section, suggest speakers and subjects, and to take an active part in discussions. It was recommended that each member upon addressing the Chair give his name and the firm with which he is connected, in order that the members might become more readily acquainted.

Meeting adjourned at 7.45 o'clock.

HOWARD C. THOMAS,
Temporary Clerk.

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* The By-Laws of this Section, as approved by the Board of Government May 19, 1920, are appended hereto.

BY-LAWS OF THE DESIGNERS SECTION.

ARTICLE I.

SECTION 1. The object of the Designers Section of the Boston Society of Civil Engineers shall be the professional improvement of its members through informal discussions on the design of engineering works, and the encouragement of social intercourse particularly among the younger members of the Society.

ARTICLE II.

SECTION 1. The membership of the Designers Section shall consist of Members, Juniors and Associates.

SECT. 2. Eligibility to office and the right to vote shall be limited to the membership of the Section.

ARTICLE III.

SECTION 1. Members, Juniors and Associates of the Boston Society of Civil Engineers shall be entitled to membership in this Section as Members, Juniors and Associates, respectively, upon making written application to the Executive Committee of the Section.

SECT. 2. Members, Juniors and Associates of the Boston Society of Civil Engineers, who are not enrolled as members of the Section, shall be entitled to attend all meetings of the Section and take part in the discussion of professional subjects, but shall have no vote.

ARTICLE IV.

SECTION 1. The officers of this Section shall be a Chairman, Vice-Chairman and Clerk.

The general government of this Section shall be vested in an Executive Committee, consisting of the President of the Boston Society of Civil Engineers, the Chairman, Vice-Chairman, Clerk and three others from the membership of the Section.

SECT. 2. The Chairman of the Section shall represent the Section at the meetings of the Board of Government of the Boston Society of Civil Engineers, with the privilege accorded under its By-Laws.

SECT. 3. The term of office of all officers and committees shall extend to the next succeeding annual meeting or until their successors are elected or appointed.

SECT. 4. All officers and committees shall assume their duties immediately after the close of the meeting at which they have been elected.

SECT. 5. Vacancies occurring in any office may be filled by ballot at the first meeting after notice of the same has been sent to each member, a majority of the votes cast being necessary to elect.

ARTICLE V.

SECTION 1. The Chairman shall have a general supervision of the affairs of the Section. He shall preside at meetings of the Section. In case of his absence or a vacancy in his office, the Vice-Chairman shall discharge his duties.

SECT. 2. The Executive Committee shall have control of the management of the Section, subject to the action of the Section at any meeting, and shall make the necessary arrangements for all meetings. All questions in Executive Committee shall be decided by a majority vote, and four members shall constitute a quorum. Meetings of the Executive Committee shall be held at the call of the Section Chairman, or, in his absence or inability to serve, at the call of the Vice-Chairman.

SECT. 3. The Clerk shall keep the records of the meetings of the Section and of the Executive Committee, and perform such other duties as are herein prescribed and as may be required by the Executive Committee. He shall prepare and transmit to the Secretary of the Boston Society of Civil Engineers notices of all meetings and copies of the records of all meetings, papers and discussions.

SECT. 4. No expenditures shall be made or financial obligation incurred by any officer or committee of the Section, for which the Society will be responsible, without previous authorization by the Board of Government or President of the Society.

ARTICLE VI.

SECTION 1. The annual meeting of the Section shall be held in Boston on the second Wednesday in March, at which meeting the annual reports for the preceding year shall be presented and the officers for the ensuing year elected.

SECT. 2. The officers and other members of the Executive Committee shall be elected at this meeting by written ballot, from nominations made from the floor, or submitted in writing previous to the meeting and endorsed by at least ten members.

SECT. 3. The regular meetings of the Section shall be held on the second Wednesday of the months of October to May, both inclusive, unless otherwise provided by the vote of the Executive Committee.

SECT. 4. Special meetings of the Section shall be held at the call of the Chairman. At special meetings no business shall be transacted, unless announced in the call for the meeting and upon recommendation of the Executive Committee.

SECT. 5. Ten members shall constitute a quorum for the transaction of business.

ARTICLE VII.

Section 1. Proposed amendments to these By-Laws shall be submitted in writing to the Executive Committee, and shall be presented to the Section at a regular meeting, if so decided by vote of the Executive Committee. The Executive Committee shall, however, bring before the Section any proposed amendment at the written request of ten members.

Sect. 2. Announcement of a proposed amendment which is recommended by the Executive Committee or by ten members of the Section shall be given by printing the amendment in the notice of the regular meeting. A two-thirds vote of the members present and voting shall be necessary for the adoption of the amendment.

Sect. 3. All amendments to these By-Laws shall receive the approval of the Board of Government of the Boston Society of Civil Engineers before taking effect.

Boston, May 12, 1920. — A meeting of the Designers Section of the Boston Society of Civil Engineers was held in the Society rooms and was called to order at 6.00 p.m. by the Chairman, Ralph W. Horne.

The report of the previous meeting was read and approved.

Mr. Mark Linenthal was then introduced and covered his subject, "Concrete Ship Construction," in a most entertaining and instructive manner. The success of his efforts was attested by the general and active discussion which followed in the audience which numbered 25.

The meeting adjourned at 8.30 p.m.

Respectfully submitted,

A. L. Shaw, *Clerk.*

LIST OF MEMBERS.

ADDITIONS.

Cameron, Edward H.,
Care Jackson & Moreland . . 387 Washington St., Boston, Mass.
Hogue, C. J. . . . . 3734 Grand Central Terminal, New York, N. Y.
Johnson, William A. . . . . 710 City Hall Annex, Boston 9, Mass.
Longfellow, George P. . . . . 112 Chandler St., Boston, Mass.
Pitman, M. Edgar . . . . 708 City Hall Annex, Boston 9, Mass.

CHANGES OF ADDRESS.

Bailey, F. S.	14 Hillcrest Rd., East Braintree 84, Mass.
Beugler, E. J.	The Foundation Co., 120 Liberty St., New York, N. Y.
Coburn, S. E.	47 Berlin St., Wollaston, Mass.
Ewing, W. C.	American City Bureau, Tribune Bldg., New York, N. Y.
Farwell, C. A.	P. O. Box 462, Springfield, Mass.
Flett, L. E.	10 Almont St., Medford 55, Mass.
Gillett, L. A.	92 Bromfield St., Newburyport, Mass.
Kidd, A. L.	74 Grampian Way, Dorchester, Mass.
Macksey, H. V.	Supt. Dept. of Public Works, Framingham, Mass.
Shedd, G. G.	92 Park Ave., Manchester, N. H.
Van der Pyl, Edw.	5 Erickson St., Worcester, Mass.
Walker, P. B.	Church St., Whitinsville, Mass.
Webb, G. F.	P. O. Box 147, Austell, Ga.
Whitman, Ralph,	Care Bureau Yards and Docks, Navy Dept., Washington, D. C.

DEATHS.

Brown, William M.	May 28, 1920.
Burke, John R.	April 27, 1920.

APPLICATIONS FOR MEMBERSHIP.

[June 15, 1920.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Allen, Herbert Bullard, Fitchburg, Mass. (Age 40, b. Gardner, Mass.) From 1904 to 1908 with the Sewer Department, Worcester, Mass., as assistant chemist under H. P. Eddy; from 1908 to 1914 chemist in charge of the testing of materials and other chemical and photographic work in connection with the extension of the sewer system of Louisville, Ky.; from 1914 to 1918 assistant chemist for sewage disposal, Fitchburg, Mass.; and from 1918 to date chemist in charge of Sewage Disposal System, Fitchburg, Mass. Refers to H. P. Eddy, A. L. Fales, D. A. Hartwell and F. A. Marston.

Cove, Earle Howard, Readville, Mass. (Age 22, b. Oxford, Nova Scotia, Canada.) Educated in Everett High School 1914–15, and Northeastern College 1917–18; general engineering practice three years prior to 1918; transitman with the N. Y., N. H. & H. R. R., Feb., 1918, to Aug., 1918; transitman with Metcalf, Aug., 1918, to Feb., 1919; chief of party with G. H. Wetherbee, Jr., Feb., 1919, to Feb., 1920; chief of party with the Town of Watertown, March, 1920, to May, 1920, and since May, 1920, with Fay, Spofford & Thorndike. Refers to F. S. Bailey, W. T. Barnes, W. F. Learned, F. A. Marston, F. J. Maynard and G. H. Wetherbee, Jr.

Kennison, Karl Raymond, Boston, Mass. (Age 34, b. Marysville, N. B.) Graduate Colby College, Waterville, Me., June, 1906, and graduate of Mass. Institute of Technology, in Mechanical Engineering, June, 1908. Draughtsman with American Bridge Co., East Berlin, Conn., until Sept., 1906; with inspection department, Association Factory Mutual Ins. Co., Boston, as draughtsman, surveyor and sub-assistant, until June, 1909; draughtsman with J. R. Freeman until Sept., 1909; instructor in mathematics and drawing at Colby College, introducing new technical courses, until June, 1910; assistant resident engineer at Holter Dam, Mont., also in charge of river gagings, until Dec., 1910; principal assistant to J. R. Freeman on water supply and water-power projects, in charge of designs, estimates and survey, until Oct., 1915; assistant engineer, Water Supply Board, Providence, R. I., on new water supply and power development now under construction, until Jan., 1918; supervising engineer, Bureau of Yards and Docks, at Blake & Knowles Works, East Cambridge, in charge of extensive plant additions, until June, 1918; supervising plant engineer, Emergency Fleet Corporation, Mobile, Ala., in charge of construction of new concrete shipyard, until Dec., 1918; assistant plant engineer, Emergency Fleet Corporation, in charge of Middle Atlantic District office until May, 1919; and in charge of western section of Southern District to May, 1920; in charge of construction of 10 000-ton dry dock and repair plant at New Orleans, 10 000-ton dry dock and piers at Mobile, 5 000-ton dry dock at Pensacola, and other less important constructions. Is an associate member of Am. Soc. of Civil Engineers. Refers to Harold K. Barrows, Bertram Brewer, Frederick Otis Clapp, John R. Freeman, J. Arthur Garrod, X. H. Goodnough, Ralph H. Stearns, Joseph F. Wilbur, Frank E. Winsor.

THE M. I. T. CO-OPERATIVE PLAN A PROVED SUCCESS.

For the past year an interesting experiment in coöperative engineering education has been conducted by the Massachusetts Institute of Technology and the General Electric Company. While the coöperative scheme in itself is not new, several departures from the usual plan were introduced, which have produced decided results.

The class was limited to thirty students, who were chosen entirely upon the records which they had made in the equivalent of the first two years' work of the Electrical Engineering Course at Technology. Included in this group were graduates from Yale, Harvard, Dartmouth, Princeton, the Naval Academy, besides men who had completed their first and second years solely at Technology. The year (12 months) is divided into four three-month periods, the students spending alternately thirteen weeks at the Lynn works of the General Electric Company and eleven weeks at the Institute, followed by a two weeks' vacation. The group at Lynn is housed together in a fine old residence which has been converted into a modern clubhouse. No break is made in the major studies when the students are at Lynn, — courses being conducted at the Works in Principles of Electrical Engineering and in General Studies. The progress of the students through the plant is regulated not by the production needs of the various departments but by the advantage which the experience in each department is to the students.

The result of this year's work has been gratifying to the originators of the plan. Because the students were a selected group, were all taking the same course, and were thrown together intimately at work and at the clubhouse, an intense spirit of loyalty to one another, to the Institute and to the General Electric Company soon became manifest, and every man strove to make a reputation for the course. With the students attacking the work in this frame of mind, it is not surprising that their enthusiasm was soon shared by the officials and superintendents of the coöperating company, who are unanimous in stating that the work done in the shops has been preëminently satisfactory. As evidence of its approval of the work, the company has increased the number of men who can be enrolled in this year's class to sixty and has already secured a new clubhouse in order to furnish rooming accommodations for them. The new class which has already nearly completed its quota of members will enter upon the work July 6.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Accidents at Metallurgical Works in the United States, 1918. Albert H. Fay.

Absorption as Applied to Recovery of Gasoline Left in Residual Gas from Compression Plants. W. P. Dykema and Roy O. Neal.

Anticlines near Maverick Springs, Fremont County, Wyoming. A. J. Collier.

Approved Explosion-Proof Coal-Cutting Equipment. L. C. Ilsley and E. J. Gleim.

Architectural Concrete Stone and Concrete Blocks in 1917 and 1918. G. F. Loughlin.

Asbestos in 1918. J. S. Diller.

Asphalt and Allied Substances in 1918. C. C. Osbon.

Bauxite and Aluminum in 1918. James M. Hill.

Boiler and Furnace Testing. Rufus T. Strohm.

Census of Electrical Industries, 1917.

Cement in 1918. Ernest F. Burchard.

Coal-Mine Fatalities in the United States, 1919. Albert H. Fay.

Copper in 1917. (General Report.) B. S. Butler.

Data of Geochemistry. Frank Wigglesworth Clarke.

Deposits of Manganese Ore in Nevada. J. T. Pardee and E. L. Jones, Jr.

Determination of Mercury. C. M. Bouton and L. H. Duschak.

Gold, Silver, Copper, Lead, and Zinc in California and Oregon in 1918. Charles G. Yale.

Gold, Silver, Copper, Lead, and Zinc in Colorado in 1917. Charles W. Henderson.

Gold, Silver, Copper, Lead and Zinc in Utah in 1918. V. C. Heikes.

Iron Ore, Pig Iron and Steel in 1918. Ernest F. Burchard.

Mineral Resources of the United States, 1917.

Mineral Waters in 1918. Arthur J. Ellis.

Mining in Northwestern Alaska. S. H. Cathcart.

Manganese and Manganiferous Ores in 1918. D. F. Hewett.

Mining in the Matanuska Coal Field and the Willow Creek District, Alaska. Theodore Chapin.

Potash in 1918. W. B. Hicks.

Report of the Chief of the Weather Bureau, 1918–19.

Secondary Metals in 1918. J. P. Dunlop.

Strontium in 1918. George W. Stose.

Surface Water Supply of the United States in 1916. Nathan C. Grover, chief hydraulic engineer.

Talc and Soapstone in 1918. J. S. Diller.

Work on Mineral Resources done by the U. S. Geological Survey. Edson S. Bastin and H. D. McCaskey.

Waste and Correct Use of Natural Gas in the Home. Samuel S. Wyer.

Zinc in 1917. C. E. Siebenthal.

State Reports.

Connecticut. Annual Report of the Highway Commission, October, 1918, to June 30, 1919.

New York. Report of the Investigation and Study of the Route of the Improved Erie Canal between the Cities of Tonawanda and Buffalo.

New York. Report of the Board of Conference relative to the Proposed Waterway between Gravesend and Jamaica Bays.

New York. Supplemental Report of the Jamaica Bay–Peconic Bay Canal Board.

New York. Report of the State Engineer and Surveyor, on the Survey of Route and Estimate of Cost for Constructing a Branch of the Barge Canal from the Seneca River to Auburn.

New York. Report of the State Engineer and Surveyor J. A. Bensel on Surveys of Black River Canal Extension, Chemung Canal Reconstruction, Glenns Falls Feeder Conversion, Flushing River and Jamaica Bay Canal Construction, and Newtown Creek-Flushing Bay Canal Construction.

New York. Report of the Board of Conference relative to the Proposed Improvement of the Harlem River.

Massachusetts. Annual Report of the Public Service Commission.

City and Town Reports.

Belmont, Mass. Report of Water Commissioners, 1919.

Boston, Mass. Annual Report of Transit Department, 1918.

Boston, Mass. Twenty-Fourth and Final Report of Transit Commission, 1918.

Concord, N. H. Annual Report of the Board of Water Commissioners.

Detroit, Mich. Annual Report of the Board of Water Commissioners.

Fall River, Mass. Annual Report of the City Engineer, 1919.

Providence, R. I. Annual Report of the Department of Public Works.

St. Paul, Minn. Annual Report of the Board of Water Commissioners.

Somerville, Mass. Annual Report for 1919.

Springfield, Mass. Annual Report of the Water Commissioners, 1919.

Springfield, Mass. Municipal Water Works, 1919.

Miscellaneous.

Transactions of the American Institute of Mining and Metallurgical Engineers. Vol. lxi.

Effect of Storage. Duff A. Abrams.

Engineering for Land Drainage. Charles Gleason Elliott, C. E.

Deterioration of Structures in Sea-Water. First Report of Committee of the Institution of Civil Engineers.

Engineering Index, 1919. American Society of Mechanical Engineers.

Library Committee.

Vol. VII JUNE, 1920 No. 6

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

THAMES RIVER BRIDGE.

BY JAMES W. ROLLINS,* PAST PRESIDENT, BOSTON SOCIETY OF CIVIL ENGINEERS.

(Presented April 21, 1920.)

THE problem of constructing a bridge across the Thames River at New London was a most complex one, the river being about 1 400 ft. wide, the water 50 ft. deep at the center of the river, and rock bottom 100 ft. to 180 ft. below water level.

When the question of a bridge at this location was first discussed in 1856, it was considered to be beyond the limit of finance and the engineering resources of the day, and not until 1889 were these difficulties removed and the bridge built and opened to traffic with proper ceremonies on October 10 of that year.

It was a double-track structure, 1 432 ft. long, with a draw span of 503 ft., this span remaining the longest in the world for many years.

The plan for constructing the deep foundations was a novel one and compares most favorably with very recent practice for timber grillage foundations, and it is rather difficult to see why the foundations were not more permanent.

The work was done in this way: First, the soft mud was dredged out to a depth of 20 ft. below the bottom of the river. A crib of 12 ins. by 12 ins. hemlock timber was built, with 8 center pockets, each about 20 ft. by 8 ft., without bottoms, but with loading pockets on the outside. This crib was sunk to the dredged bottom of the river. Piles, sufficient in number to carry the load of masonry and superstructure, were then driven in the center pockets. These piles were of Oregon fir and yellow pine, 60 ft. to 80 ft. in length, and were sawed off by a water machine saw at depth of 60 ft. below water surface.

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*Of Holbrook, Cabot & Rollins, 6 Beacon St., Boston, Mass.

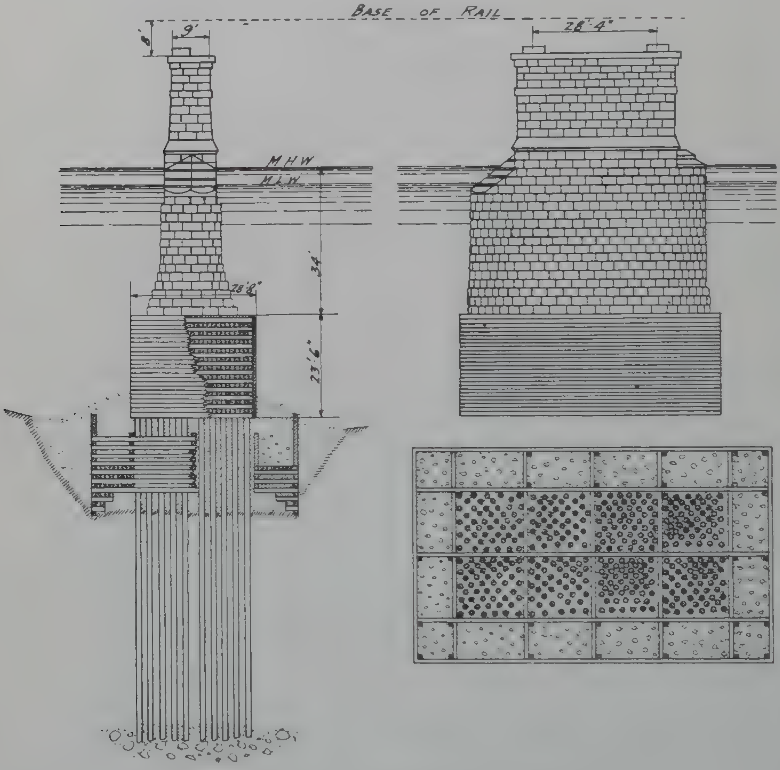


FIG. 1. — PIER IN ORIGINAL BRIDGE.

The work of sawing off the piles was, according to notes of the engineers, the most difficult part of the work.

The masonry was built in timber caissons, with a thickness of bottom timber (rough hemlock) of 23 ft. in center piers, with the usual timber side for open-caisson construction. On account of the great thickness of the grillage, 23 ft., some difficulty was met in keeping the caissons from tipping over.

About 1905 the old bridge began to move, and some of the piers settled to such an extent that in 1908 the traffic was cut down to a single "gauntleted" track.

The movement of the old bridge foundations is described as follows by Mr. W. H. Moore, engineer of structures, of the New York, New Haven & Hartford Railroad Co.:

"Shortly after the bridge went into service, Pier No. 1, counting from the west end, began to settle, the total settlement, if I remember, being some 18 ins. to 24 ins. This pier was founded on a gravel bed which was exposed at low water. Piles were driven through the gravel and cut off, I think, about 3 ft. or 4 ft. below the surface. When the settlement took place, Mr. Dawley drove several rows of piles all around the pier and built masonry on these piles, which was built into the pier so as to underpin it and distribute the pressure to the new pile work. No subsequent settlement of this pier took place.

"The pivot pier settled unevenly and very slowly, tipping toward the southeast in a plane approximately at 45 degrees to the axis of the bridge. This tipping did not disturb to any great extent the elevation of the top of the pier. Several times during the life of the bridge we have moved the swing span bodily on the top of the pier to bring the center of the turntable back into the axis of the bridge, at the same time leveling up the bearings for the wheels. This movement shortened the distance between the pivot pier and easterly rest pier while lengthening the distance between the pivot pier and the westerly rest pier, so that, from time to time, we had to cut off portions of the superstructure at the east end to maintain a proper clearance for operating the bridge. After this movement had proceeded for a considerable amount, the bearing of the westerly end of the draw span was coming so close to the edge of Pier No. 2 that we built up a concrete facing on the east side of this pier some 18 ins. wide, reënforced with steel columns and tied securely into the pier.

"The movement of the pivot pier was rather peculiar; sometimes it would move at a practically uniform rate for several years and then would come a period of five or six years during which no movement was noted. Then again it would begin to move. I tried to check up these irregular movements with the periods at which heavier engines were purchased and

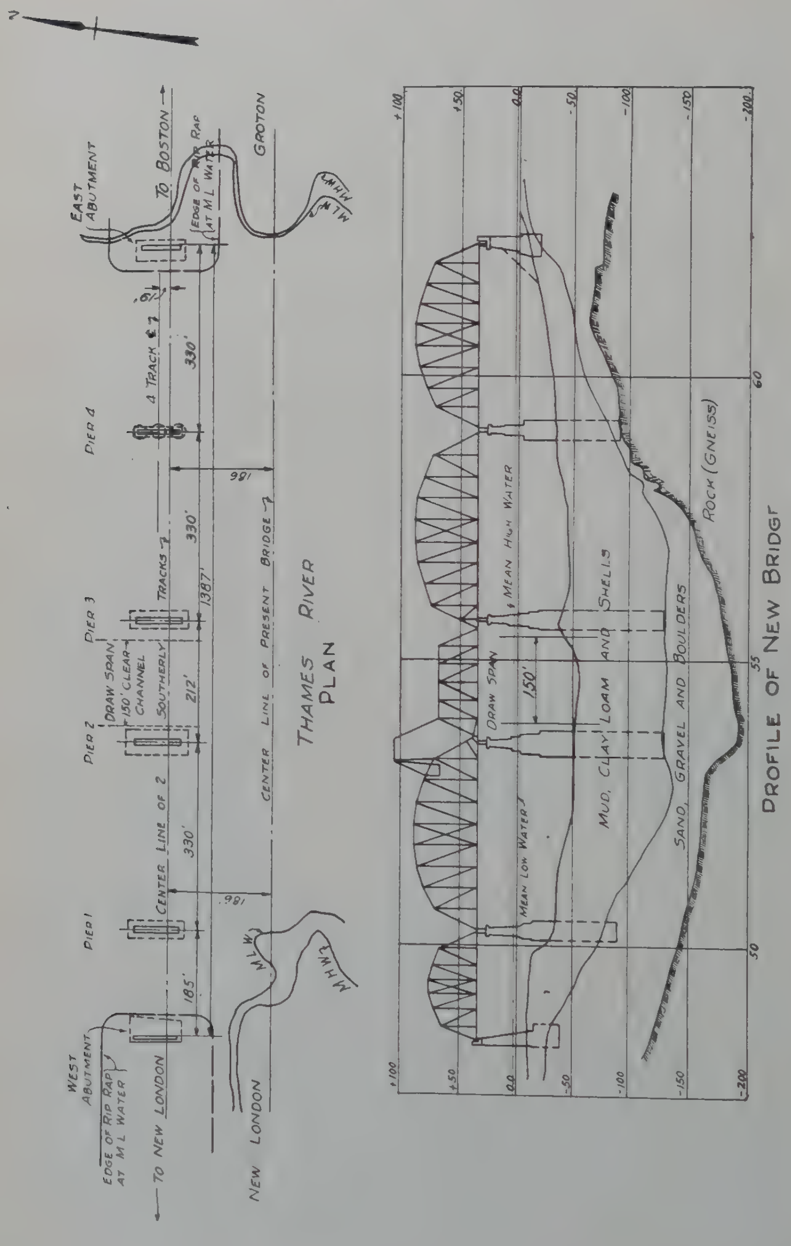


FIG. 2. — PLAN AND PROFILE OF NEW BRIDGE.

put into operation on the Shore Line, but the periods did not seem to coincide closely enough to warrant the definite statement that movements began after heavier engines were put on. However, I think that this had something to do with the starting of the periodical movements."

Studies were then begun for a new bridge. A profile of the river bottom at the site of the new bridge is given. (Fig. 2.)

Various studies were made as to type of foundations: First, a pile concrete grillage, open-caisson type; but this was finally abandoned on account of the failure of the old bridge, which was built in this way.

At the request of one of the engineers of the N. Y., N. H. & H. R. R., the writer at one time made a study, report and estimate of this type, and is still of the opinion that a modern type of construction of the pile open-caisson method would have have been as satisfactory and stable and much less expensive than the open-crib construction plan, which was finally used.

The worst condition affecting the piers was in the center of the river, where the water was 50 ft. deep, mud and clay 80 ft. thick — a total distance of 130 ft. to suitable gravel foundation.

The writer's plan was to dredge out 20 ft. of mud, fill the hole up 10 ft. with crushed stone, and then drive piles 75 ft. long through the crushed stone into hard gravel and sand stratum, sawing off piles at −60, filling up balance of dredged bottom with riprap to −50, the original bed of river.

The masonry would then have been built on a concrete reënforced grillage sunk on to the piles.

The writer believes that in the consideration of this type for foundations some question arose as to the effect of this dredging and pile driving on the old bridge foundations, the center lines of the two bridges being only 186 ft. apart, and possibly this fear led to the abandonment of the pile open-caisson method.

A four-cylinder open caisson was also studied, but abandoned on account of the doubts as to being able to control the sinking of these cylinders to the great depth necessary.

The final and accepted study was for rectangular open-crib caissons, and after most extensive borings had been made the final plans were drawn, bids were asked for, and contract awarded to Holbrook, Cabot & Rollins Corporation in March, 1916.

The terms of the contract were somewhat novel, and were as follows:

The contractor guaranteed that the cost of the foundations according to the plans submitted would not exceed eight hundred and seventy-five thousand dollars, that any excess cost above that sum was to be paid by the contractor, and any saving of cost below the above sum would be divided equally between the contractor and the Railroad Company. The contractor was to be given a fixed fee of eighty thousand dollars for doing the work.

This plan worked out most satisfactorily, as the Railroad Company paid at once for all material bought, and under these conditions we bought all the material for the whole job, and piled it up for use as needed: so that with the possible exception of gravel for concrete, we did not have to wait at all for material.

Another great advantage in this form of contract where both the company and the contractor had a direct money interest in the cost (as we divided the saving) was the close and cordial coöperation between engineers and contractor, to do the work in the most economical manner. Everybody worked for the best interest of the job; no pet schemes or new theories were tried out, for we all realized that we had a most difficult problem, which was a new one for all of us, and that it needed thought, brains and the most diligent attention, in order to be carried through with success.

Apart from the paper proper, a new thought comes to the writer in thinking over this form of contract. It is common practice now to make contracts of a fixed fee basis, with a provision for division of saving, and the new thought is to divide the saving into thirds: one to the company, one to the contractor, and the third to the *engineer*. This might work out to the benefit of all, and the writer is sure that any reputable contractor would be glad to give up 17 per cent. of his bonus, to help a worthy and helpful engineer.

The contract plans provided for two abutments on gravel

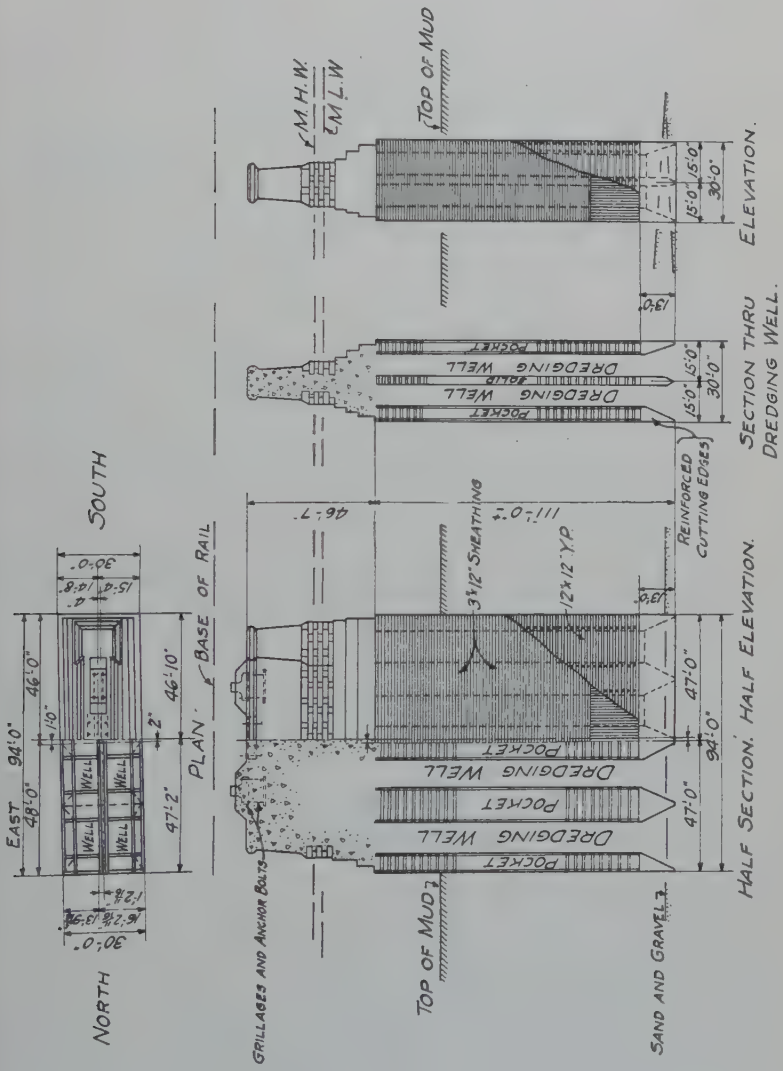

NORTH
SOUTH
EAST
94'0"
48'0"
46'0"
30'0"
15'4"
14'8"
4"
1'0"
2"
WELL
PLAN
BASE OF RAIL
46'10"
47'2"
16'2 1/16
13'9 5/8
1'2 1/4
M.H.W.
M.L.W.
TOP OF MUD
GRILLAGES AND ANCHOR BOLTS
POCKET
DREDGING WELL
SOLID
46'7"
111'0"±
3"x12" SHEATHING
12"x12" Y.P.
13'0"
47'0"
15'0"
30'0"
REINFORCED CUTTING EDGES
SAND AND GRAVEL
HALF SECTION. HALF ELEVATION.
SECTION THRU DREDGING WELL.
ELEVATION.

Fig. 3. — Pier 3.

foundations: the westerly abutment 40 ft. below water, the easterly abutment 20 ft. below water; and for four piers: three open cribs sunk to hard gravel, 90 ft., 130 ft. and 131 ft, respectively, below water, and the fourth pier built on three pneumatic foundations sunk to solid rock, from 60 ft. to 90 ft. below water. Pier 3, as typical, is shown in Fig. 3.

Plans of cribs showed an alternate design for cutting edge, of wood or of reënforced concrete, and on account of the probable difficulty in making all the mitre joints in heavy timber, it was decided to build the cutting edges of reënforced concrete. Fig. 4 is a plan of the bottom section of the crib, showing cutting edges, and Fig. 5 photograph of crib under construction.

A problem at once developed as to how to build these concrete "cutting edges," which were 42 ft. by 99 ft. in outline, and 13 ft. high, containing 700 cu. yds. of heavily reënforced concrete, and weighing 1 500 tons; with the necessary caisson sides built on to the cutting-edge section, the combined structure drawing 30 ft. of water, when there were no launching ways available for that depth of water and the cost to build special ways for this work was prohibitive.

There was available a ship railway with an extreme draught of 20 ft., and consideration was given to some method of construction which would permit the use of this railway on which to build these cutting-edge sections.

It was at once seen that use must be made of the air spaces in the dredging wells for flotation, for with this space available the *draught* of the cutting edge section was reduced to 13 ft.

This was done by building a solid floor of 4-in. plank on heavy cross timber, this floor being calked on the bottom, and then building the entire crib on this plank floor, making a watertight connection between the floor and the outside cutting edge, and finally holding the floor tight to the crib by cables from the 12 in. by 12 in. cross timbers on which the floor was built, up to timber across the top of the crib.

To hold the pressure against the false bottom at the open spaces at the bottom of the dredging wells, heavy trusses were built into the concrete in all the dredging wells, so constructed as to allow their removal after the false bottom was released from the crib. These trusses are shown in Fig. 6.

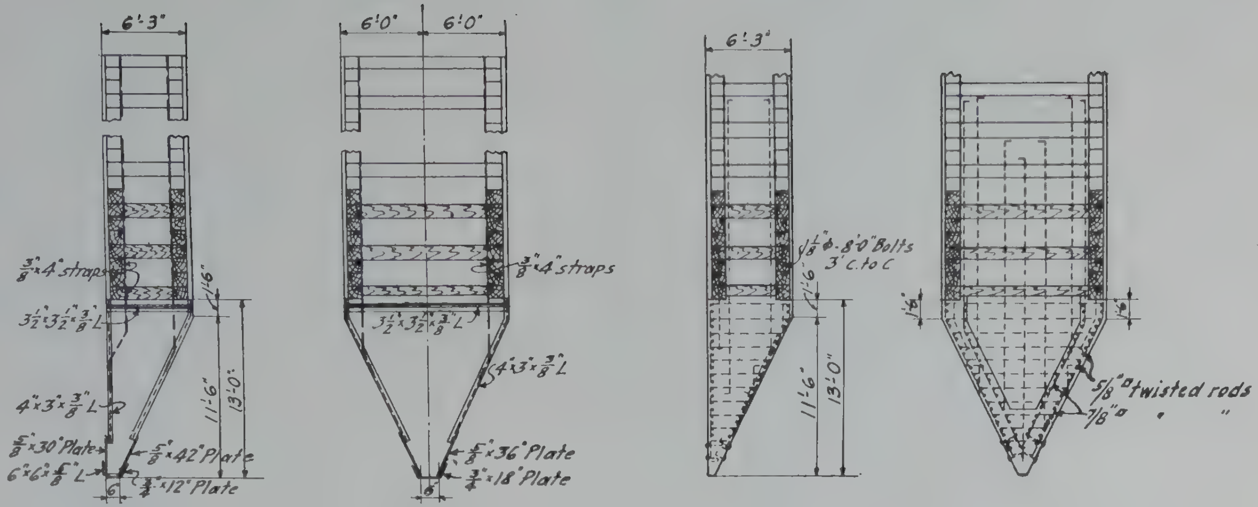


Fig. 4. — Section of Crib showing Cutting Edges.

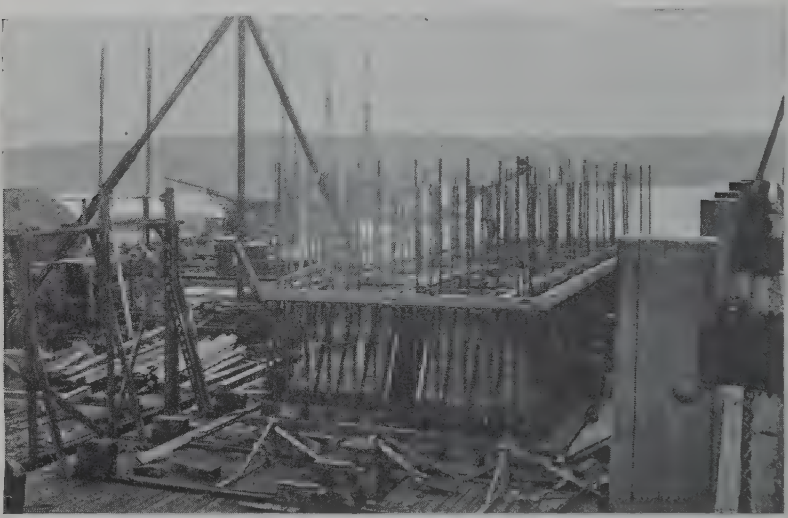


Fig. 5. — Cutting Edge of Pier 3 on Railway, showing Reinforcement.

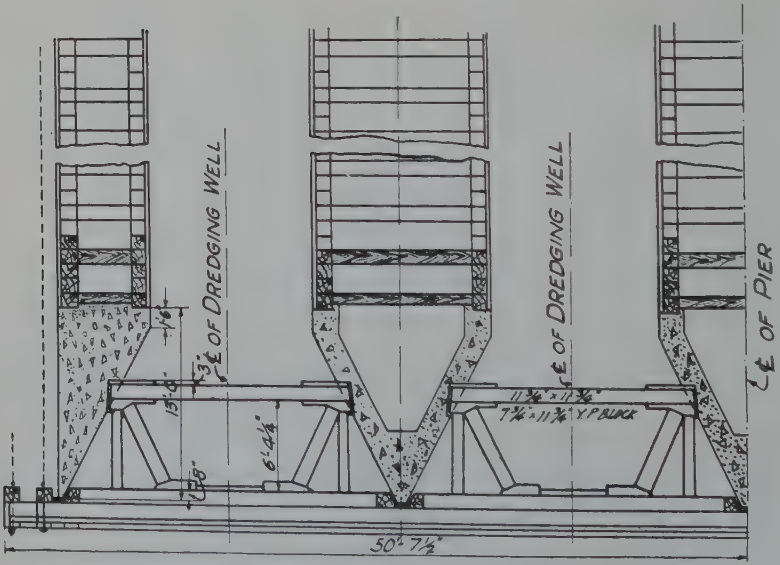


Fig. 6. — Method of Construction of False Bottom.

This plan was entirely successful, and cribs were built on the ship railway to about 20 ft. in height, floated off the railway and towed to the site of the work, and then built up to a height of about 40 ft.

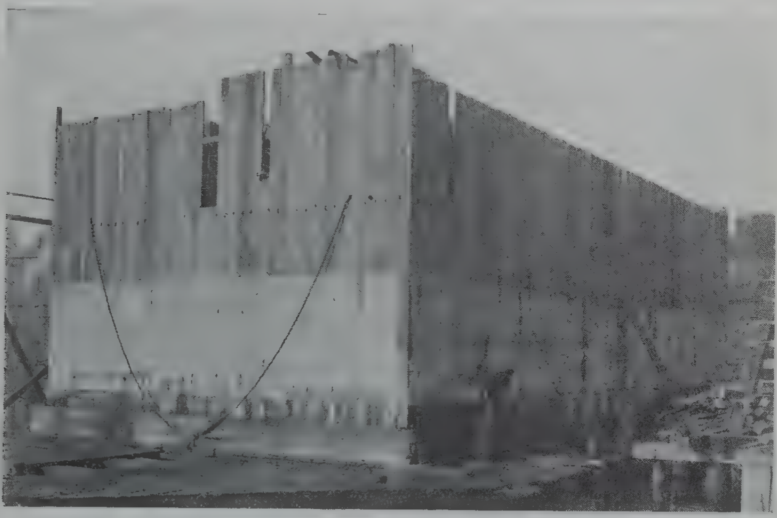


Fig. 7. — Crib on Railway, Ready for Launching.

To detach the plank bottom, the cables were loosened, and clay dumped through the dredging pockets on to the temporary floor, and when enough was dumped to overcome the flotation of this floor, it was detached from crib and dropped to the bottom of the river, and then the crib was towed into its final position, ready for sinking.

The crib proper was built of 12 in. by 12 in. timber, solid on the outside, with one longitudinal and one lateral timber, every third timber being an independent course on the outside of the crib, and around the dredging wells.

The longitudinal and laterals were halved at connection with the outside timbers of the crib, but only drift-bolted on all interior connections.

Serious trouble developed on account of the weakness in the interior connections at the dredging wells. When the temporary bottom of Pier 2 was knocked loose and the dredging wells began to fill with water, the crib began to sink, and finally brought up on the bottom of the river, in 50 ft. of water, with the top timbers of the crib about 12 ft. under water; and, to add to our misfortune, this crib was sunk on the exact site of Pier 2. We then were up against the proposition of raising a crib weighing 2 000 tons, sunk in 50 ft. of water; and right here began the coöperative working of brains and ingenuity, to solve the problem.

First it was asked: Why did the crib sink? And after a little talk and brain work, the question was answered. When the false bottom was loosened from the crib the water filled the dredging wells, which were water-tight, and this brought the resultant hydrostatic pressure on the sides of the dredging wells, which were surrounded by open air spaces, which later were to be filled with concrete.

The sides of the dredging wells of 12 in. by 12 in. timber were only fastened together by two $\frac{3}{4}$ in. by 18 in. drift bolts, and these could not hold the pressure of the water, so the joints in the corners of the dredging well opened, and the water filled the air spaces, so entirely voiding the flotation power of the crib, with the 1 500 tons of concrete on the bottom cutting-edge section.

We sent divers down to examine the wreck, and they reported that the crib was practically level and the false bottom had not been entirely knocked loose from the crib, and when the crib sunk it went back on to the plank bottom in practically its *original position.*

Luck was surely with us in this, for otherwise it would have been practically impossible to float the caisson, and would have necessitated its destruction and removal — a wrecking job of appalling possibilities, especially as the wreck was on the site of Pier 2.

However, with this false bottom in place, our proposition was easy. We built a section of the crib, about 12 ft. high, floated it into position, and with weights sunk it on to the top of the submerged crib. As all pieces were alike in the crib, this section exactly fitted on to the submerged crib, and we clamped it down on to the lower section with bolts and cables, and calked the joint with divers; also we went over the old joint between the crib and the false bottom and calked that tight. This construction brought the top of the crib above the water level, and then all we had to do was to pump out the water in the dredging wells, and the crib floated.

Fig. 8 shows crib for Pier 3 in place.

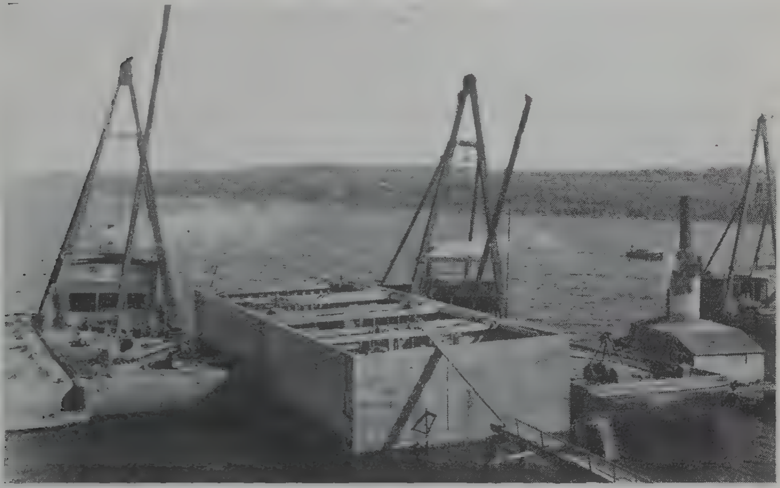


FIG. 8. — CRIB FOR PIER 3 IN PLACE.

In this way we very easily got out of what might have been a most serious calamity.

To provide for some small control in sinking the cribs through 80 ft. of mud, clay and gravel, and to help relieve the friction, an elaborate set of jets was built in the cutting edges: two jets in the walls of each dredging pocket, in diagonal corners, and three on the outside of the crib on each side, at the ends and in the center. The pipes were 4-in. in diameter, with nozzles of cast iron made to connect with these pipes, the opening in nozzles being $\frac{3}{4}$ in. All the pipes in a dredging well were connected into one pipe at the top of the dredging well, which pipe was built around the entire top of the caisson, and to which was coupled a compound duplex pump, 14 ins. by 20 ins. by 12 ins.

by 15 ins., with a 12-in. suction and 8-in. discharge, with a capacity of 1 130 gals. per minute at 165 pressure. This pump was installed on a flat boat, with a boiler of 250 h.p. furnishing steam at 150 lbs. pressure to run the pump. (Fig. 9.) Although much time and money were spent on this jetting system, it was not a success, for the power in the jets was not enough to do efficient work in clay, and after a short time this plan was abandoned, and a single vertical pipe was used with a horizontal pipe at the bottom, 2 or 3 ft. long, with a nozzle, of 1¼ ins. With all the power concentrated on to one nozzle tremendous pressure was developed which fairly tore the bottom of the river up, undermining bowlders and everything else within its reach. This single jet pipe was very flexible, as we could lower it into any pocket, or on the outside of the crib at any point where we thought the crib was being held up.

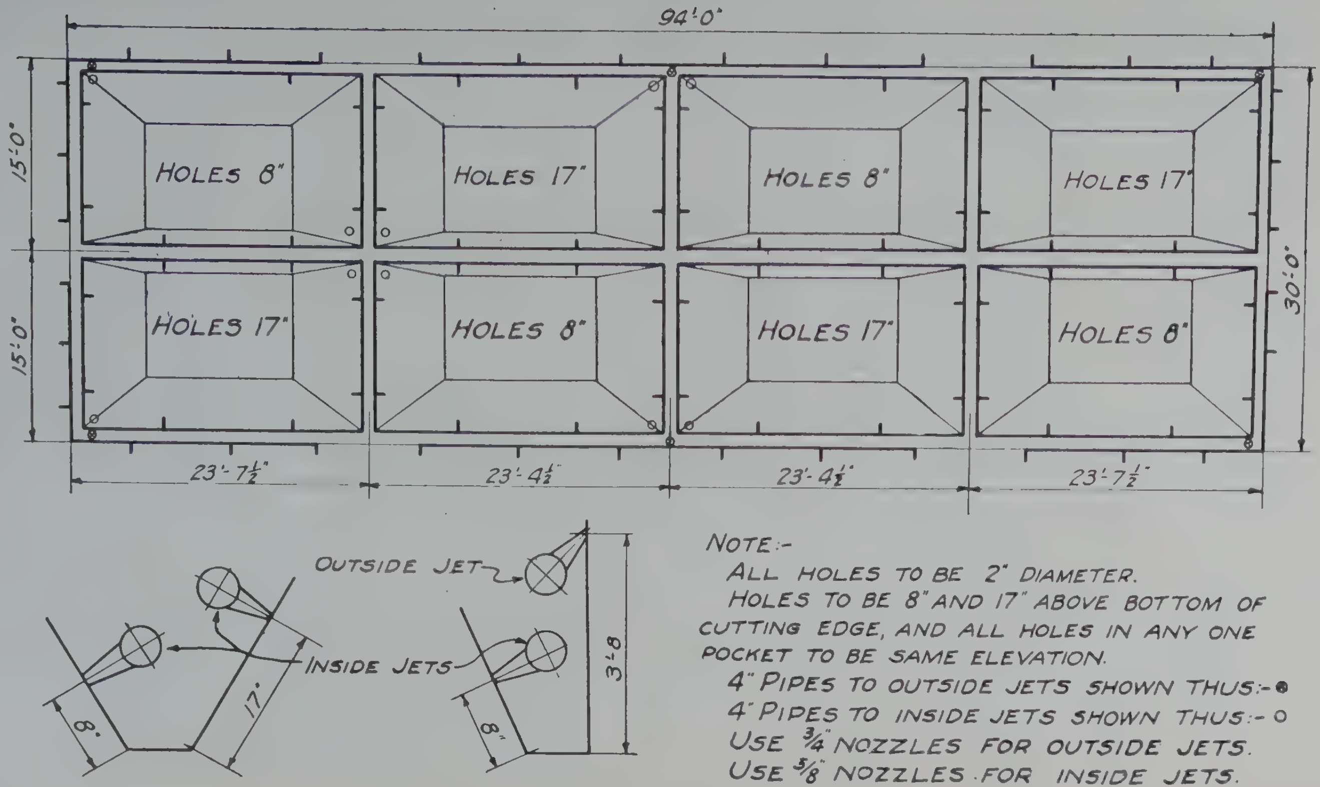
Pier 2 took an ugly slant when about 100 ft. down, and it took a lot of "jockeying" of the crib, using a jet, excavating in the necessary pockets, and loading others with concrete and stone, until finally the crib was sunk to grade and straightened up, with the result that it was about 2 ft. out of position. As this caisson was 42 ft. wide there was plenty of room for adjustment of this variation. In a gravel stratum it was easy to control the sinking of the crib, but the clay at times seemed to vary in consistency, and tend to make the crib slip.

As before stated, Piers 1, 2 and 3 were founded on wooden cribs sunk by dredging through open well, into a gravel stratum 90 ft. to 130 ft. below water level, the rock in this section of the river being from 145 ft. to 185 ft. from water level.

For Pier 4 a rock bottom was attainable at elevation −70 to −100, the rock surface dropping up stream across the foundation at an approximate angle of 25 degrees. (Fig. 10.)

The original plan was for two cylindrical piers, 28 ft. in diameter. On account of the great declivity in the rock this plan was abandoned and three cylinders of 22 ft. adopted; the tops of the cylinders being at grade −9, and the solid masonry pier beginning at that elevation.

These cylinders had a heavy metal cutting edge, with an air shaft in the center 8 ft. in diameter. (Fig. 11.) The outside shell



NOTE:-

ALL HOLES TO BE 2" DIAMETER.

HOLES TO BE 8" AND 17" ABOVE BOTTOM OF CUTTING EDGE, AND ALL HOLES IN ANY ONE POCKET TO BE SAME ELEVATION.

4" PIPES TO OUTSIDE JETS SHOWN THUS:- ⊗

4" PIPES TO INSIDE JETS SHOWN THUS:- ○

USE ¾" NOZZLES FOR OUTSIDE JETS.

USE ⅝" NOZZLES FOR INSIDE JETS.

Fig. 9. — Arrangement of Jet Nozzles.

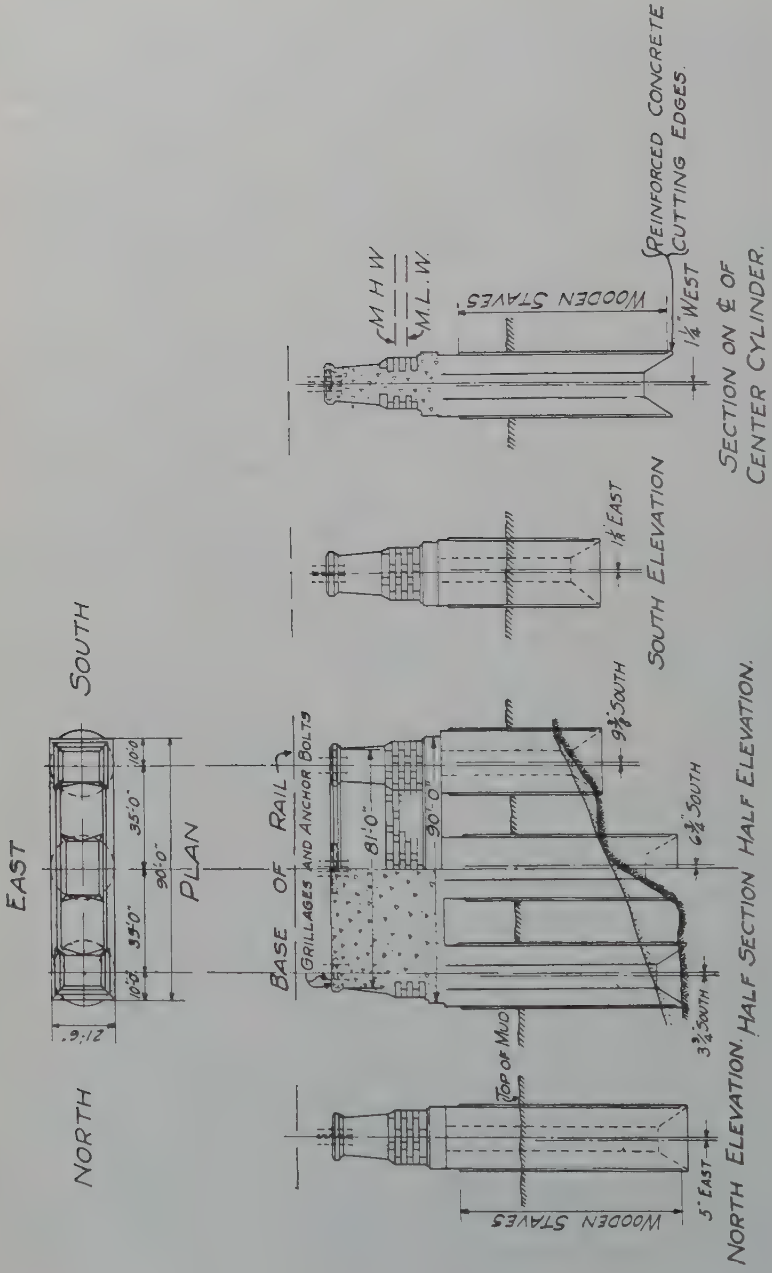

EAST
NORTH
SOUTH
21'6"
10'0"
35'0"
90'0"
35'0"
10'0"
PLAN
BASE OF RAIL
GRILLAGES AND ANCHOR BOLTS
81'-0"
90'-0"
TOP OF MUD
WOODEN STAVES
5" EAST
NORTH ELEVATION.
HALF SECTION HALF ELEVATION.
3¾" SOUTH
6¾" SOUTH
9⅜" SOUTH
1⅛" EAST
SOUTH ELEVATION
M.H.W.
M.L.W.
WOODEN STAVES
REINFORCED CONCRETE
CUTTING EDGES.
1¼" WEST
SECTION ON ℄ OF
CENTER CYLINDER.

Fig. 10. — Pier 4.

above the plate iron cutting edge, which was 15 ft. high, was built of wooden staves 4 ins. thick, with suitable bands or hoops on the inside to which the staves were bolted, these outside staves being braced like a wheel's spokes to the iron air shaft. (Fig. 12.) These cylinders were built on the marine railway to a height above flotation line, launched and floated down the river to the bridge site. (Fig. 13.)

This was another interesting problem. The water at this pier was 35 ft. deep, with a stratum of mud, shells and clay 20 ft. thick below that, making the proposition of a cofferdam around the cylinders an expensive one, requiring 55 ft. to 60 ft. sheeting.

The final plan was to sink the cylindrical caissons to rock by pneumatic process, build the masonry to grade −9, and then fill up the air shafts and pockets with concrete, leaving the timber sides in position above high water. (Fig. 14.)

A very accurate survey was then made of the relative position of the three piers, and plans drawn showing the results.

We then made a rectangular caisson of heavily reënforced concrete, 22 ft. by 90 ft., and 6 ft. high, and which we christened the "bathtub"; this caisson was about 4 ft. larger each way than the base of the masonry pier which was to be built on it. In the bottom of this caisson we left holes about 15 ft. in diameter, the centers of these holes corresponding to the center of the cylindrical piers already sunk. Cross walls were built in the caissons cutting out these holes, so as to get sufficient air space for the flotation. (Figs. 15 and 16.)

We then built light caisson sides at the top walls and air pockets of the "bathtub," for safety in towing and handling. This bathtub caisson was also built on the marine railway and launched from it.

We had built in the top section of the cylindrical piers a large number of heavy reënforcing rods, and bent them over, so as to float the caisson into position. We also built into the concrete of the piers a piece of rubber hose to act as a gasket to keep the water out of the open pockets in the caisson.

When all was ready we floated the "bathtub" off the railway, towed it down river to the bridge site, and warped it

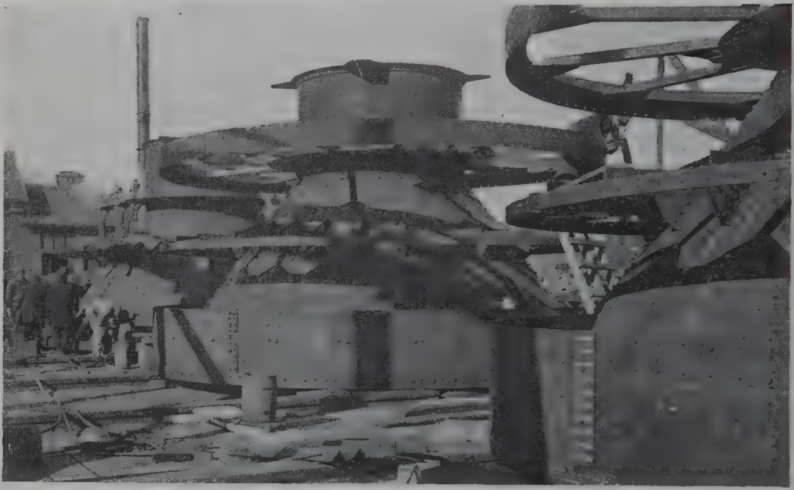


Fig. 11. — Cutting Edges, Pier 4.

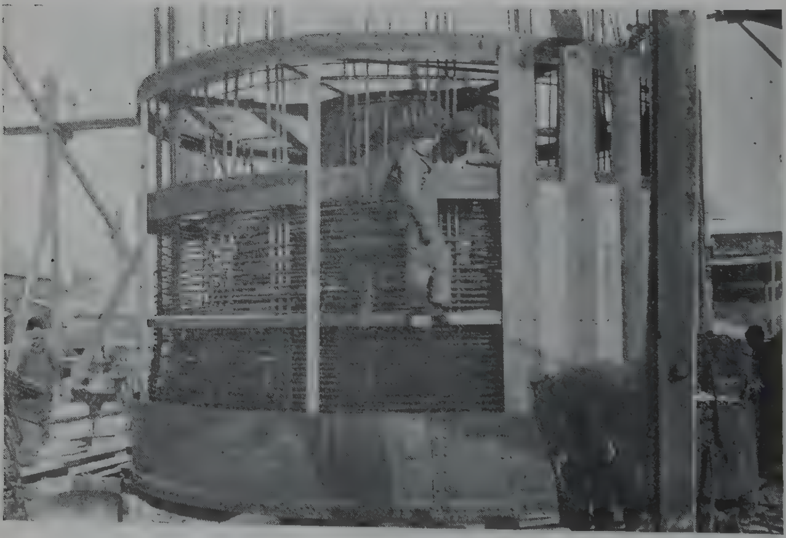


Fig. 12. — Pier 4. Cutting Edges, showing Heavy Reinforcement and Staves.

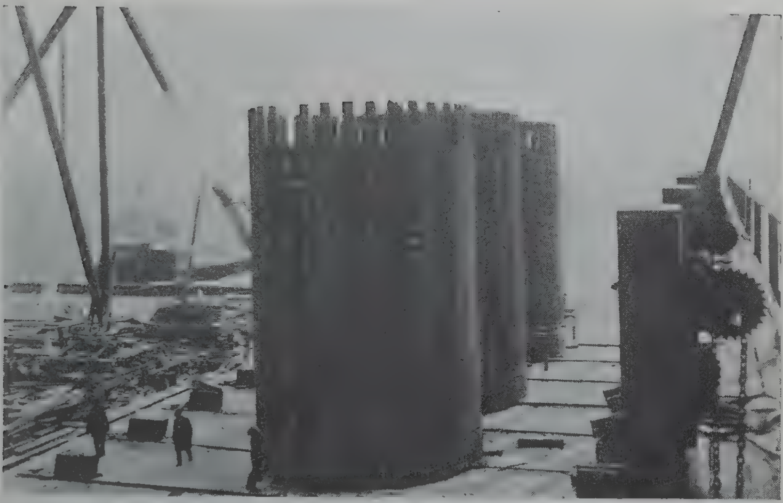


Fig. 13. — Caissons for Pier 4 on Railway, Ready to Launch.

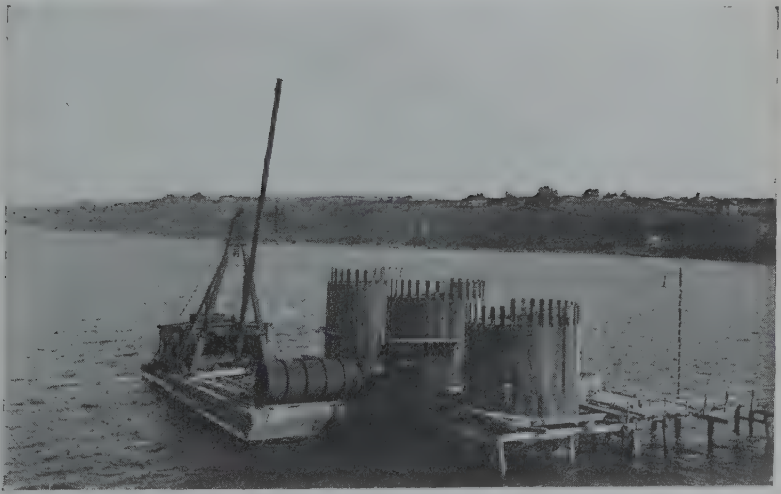


Fig. 14. — Caissons for Pier 4, Sunk to Rock Bottom.

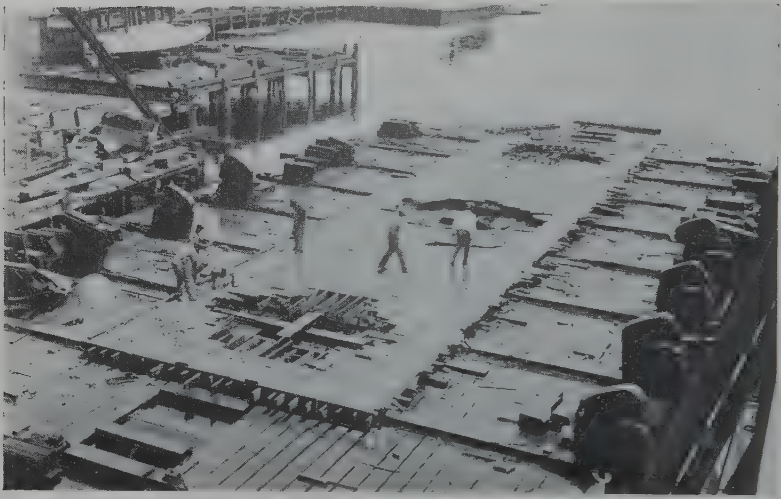


FIG. 15. — BOTTOM FOR BATHTUB ON RAILWAY.

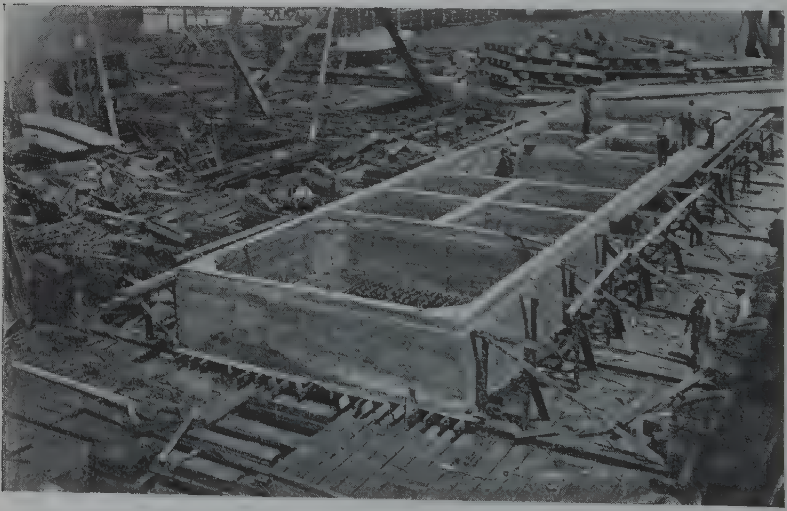


FIG. 16. — BATHTUB FINISHED, READY FOR LAUNCHING.

into exact position over the three foundation piers, and then sunk it on to them. The gaskets worked well, and we had no difficulty in pumping out the open pockets in the "bathtub," straightening out the reënforcing rods, and filling the whole structure with concrete up to elevation −3.76, the bottom of the masonry, finishing that to above high-water level, then removing the wooden sides.

The construction of the piers above the high-water mark was ordinary water work, and was completed without any trouble.

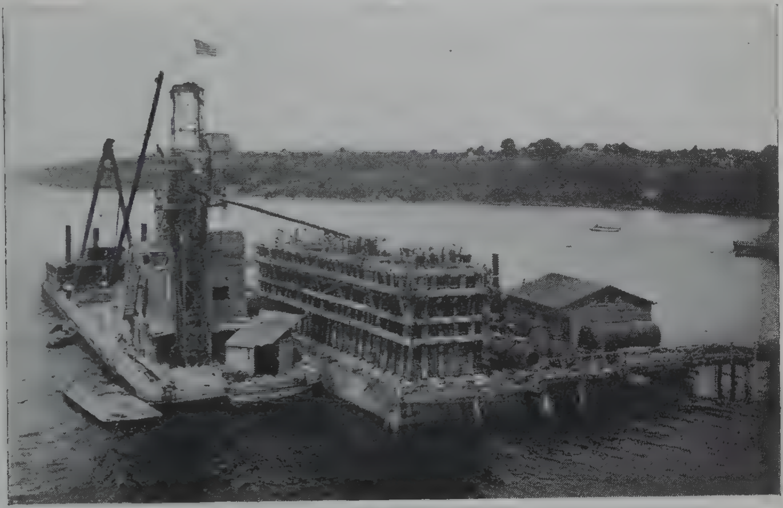


Fig. 17. — Pier 4, Masonry Done and Forms in Place for Concrete Superstructure.

The granite belt consisted of six courses, which protected the piers against action of the water between tidal limits. To maintain and preserve the joints in the granite masonry, the joints were calked hard with "wool lead."

The plant for this job was very extensive and met fully all the requirements of the work.

The concrete, of which there was 57 000 cu. yds. used, was all mixed in a floating mixing plant, an old car-float, the "Coney

Island," 195 ft. by 35 ft., with a derrick at one end, space in the center for storage of 300 tons of sand and gravel. Under the decks below this storage pile was a 24-ft. belt conveyor which carried the sand and gravel to the front end of the boat into an elevator carrying the material up into a hopper, 30 ft. above the deck. The material was dropped from this hopper into the concrete mixer and into a bucket, at bottom of a tower. The mixed concrete was raised in the tower and spouted into place in the piers, or into a bucket on the lighters for final handling.

Fig. 17 shows the "Coney Island" at Pier 4.

When we got the caissons down to a foundation satisfactory to the engineers, we began to fill up the dredging pockets, which were 8 ft. by 12 ft. in section, and 130 ft. deep. We deposited the concrete through a 12-in. tremie, up to −60, and then pumped the water out and finished the concrete in the wells in the "dry."

When we pumped the water out of the first dredging wells we found to our dismay about 8 ft. of "laitance" on the top of the concrete. We had some difficulty in getting this out on account of the free lime present, and the heat the moving of the laitance developed. Again, the men did not relish working down in that shaft, 80 ft. deep, with a bucket going up and down over their heads. We, later, excavated this laitance with a clamshell bucket, before it had set up, and had no more serious trouble from this cause.

The statistics, in part, on this bridge are as follows:

Total length of bridge, 1 387 ft.; being made in five spans, from west to east, of 185 ft., 330 ft., 212 ft. draw-span, 330 ft., 330 ft., respectively.

The work on the foundations was begun April 20, 1916, and was finished August 9, 1917, 57 114 cu. yds. of masonry being placed at an average cost, including everything, of $16.36 per cubic yard.

The total weight of the load on superstructure is estimated at 5 175 tons, and was erected at a total cost of $162.00 per ton.

All the work on these foundations was done under the direction of engineer's office of the New York, New Haven & Hartford Railroad: Mr. Edward Gagel, chief engineer; Mr. W. H. Moore, engineer of structures; Mr. I. D. Waterman, engineer of construction; Mr. P. B. Spencer, resident engineer; Mr. W. H. Law, chief inspector. And for the contractors, Mr. Luke S. White acted as superintendent, and Mr. Fred Logan, assistant superintendent; the writer representing Holbrook, Cabot & Rollins Corporation, the contractors.

The description of the original bridge is quoted from the report of Alfred P. Boller, chief engineer, New York, Providence & Boston Railroad Co., dated January 1, 1890. The figures and plans of the new bridge are from the engineering records of the New York, New Haven & Hartford Railroad Co., through the courtesy of Mr. Edward Gagel, chief engineer, Mr. Moore and Mr. Spencer, assistants.

MEMOIRS OF DECEASED MEMBERS.

JOHN STACEY HUMPHREY.*

John Stacey Humphrey was born in Marblehead, Mass., April 21, 1877, the son of Eleazer L. and Addie C. (Magoun) Humphrey.

The family moved to Laconia, N. H., in 1887 and from there to Lynn, in 1891. The boy received his education in these cities, completing his high-school course in Lynn and graduating from the Lynn Classical High School in June, 1894.

He entered the employ of the City of Boston in 1895, and worked under the direction of Mr. H. W. Foss in the coördinate survey of the Dorchester District. In 1901 he left the employ of the City of Boston to work for the Commonwealth of Massachusetts on the Metropolitan Water Supply at Clinton, and the following year left Clinton to work for the School House Commission in the City of Boston. He made a special study of the cost and construction of buildings and acted as consulting engineer for many building contractors, which led to his employment with William Crane, building contractor, as engineer and estimator. While with William Crane he was very successful and considered an authority upon cost and building construction. The buildings which were erected under his supervision while with William Crane were the Mechanic Arts High School, Parkman Memorial situated on the Boston Common, and the east and west wings of the State House. During the war the barracks at the aviation school, Cambridge, and the hospital building at Chelsea were built by Mr. Crane under his supervision.

In the fall of 1918 he severed his connection with William Crane and entered the employ of D. Cunningham & Son, and was employed in erecting other hospital buildings in Chelsea for these contractors at the time of his death.

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* Memoir prepared by Clarence B. Humphrey and Frank O. Whitney.

He became a member of the Boston Society of Civil Engineers, December 18, 1912.

He was married in August, 1902, to Z. Maude Bowlby, and is survived by his wife and two children, John S. and Elizabeth A. He died at his home in Swampscott on February 5, 1919, after an illness of ten days, with Spanish influenza.

Mr. Humphrey was a member of the Pendragon Club of Lynn, Boston City Club, and Wayfarers' Lodge, A. F. & A. M., Swampscott.

FRANK LOUIS FULLER.*

FRANK LOUIS FULLER was born July 11, 1848, in Needham, now Wellesley, and died at his home in Wellesley Hills, January 30, 1920. He was the son of Hezekiah and Emmeline (Jackson) Fuller. His death was very sudden and caused by an affection of the heart, he having been in good health up to a few minutes before the summons came to give up an exceedingly active life for a well-earned rest.

Mr. Fuller graduated from the Massachusetts Institute of Technology with the degree of S.B. in 1871, and at once took up his chosen life work as civil engineer, in which profession he was actively engaged until the day of his death. He had an office in Boston, but the sphere of his work extended into nearly all of the New England States.

Among his most important works were the original designing and construction or additions to systems of water supply in Acton, Arlington, Marblehead, Methuen, Monson, Shirley, Waltham, Ware, Webster, West Brookfield, Winchendon and Uxbridge in Massachusetts: Franklin, N. H.: Brattleboro, Northfield and Woodstock, Vt.

He became a member of this Society on June 8, 1874, being one of the large number who assisted in the revival of the Society's work at that time, and was an unusually regular attendant at its meetings, participating freely in the discussion of papers presented and in that way adding materially to the information contained in the original papers. He was one of the nine made life members about a year ago, in consideration of their services in the revival of the Society forty-five years previously, and was the third of the number who have since passed away.

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* Memoir prepared by John C. Chase.

He was a member of the American and New England Water Works associations, taking a great interest in and being a most regular attendant at the meetings of the last-named organization, contributing papers of interest and taking an active part in the discussions. He was also a member of the American Public Health Association, the Sanitary Section of this Society, the Wellesley and the Congregational clubs, and the Appalachian Mountain Club. He was a member of the Wellesley Hills Congregational Church and had served as one of the deacons for many years. He had been a member of the Wellesley Water Board since 1887 and had been its chairman for the greater portion of the time.

In 1881 he married Miss Julia L. Morrill, of Boston, who survives him.

Mr. Fuller was a high-toned Christian gentleman in all that the term implies. Whatever his hand found to do, that he did without inattention or evasion. Although having passed the three score and ten limit of the Psalmist he was not an old man, merely advanced in years, always genial and courteous with his associates of whatever age. In his decease the Society has lost a valuable member, who will be greatly missed by those with whom he has been intimately associated for nearly a half century.

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FOUNDED 1848

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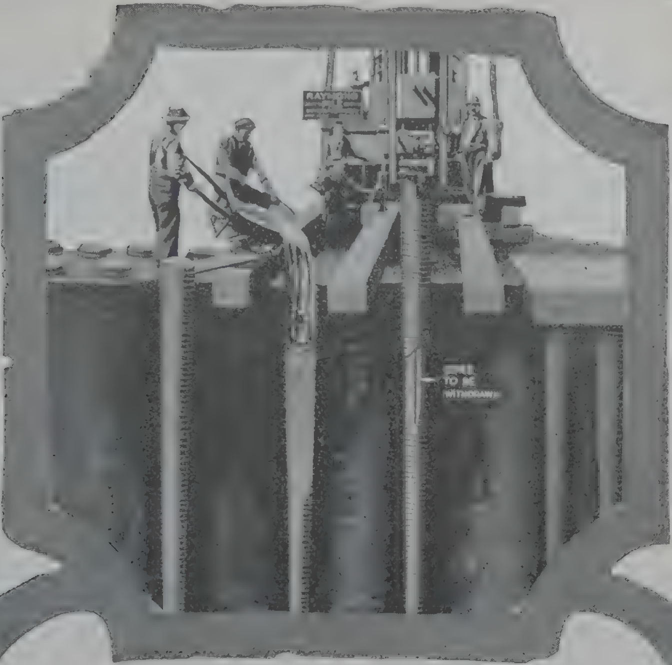

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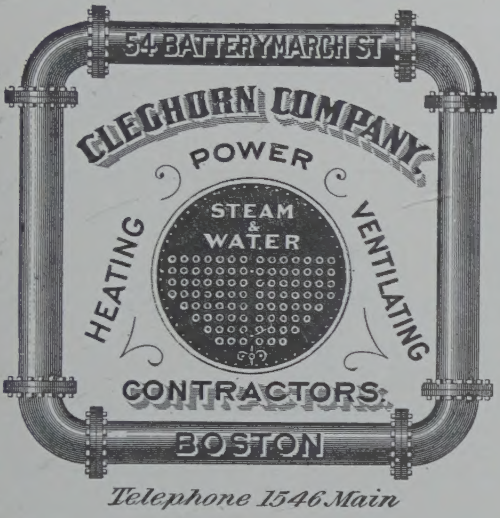

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